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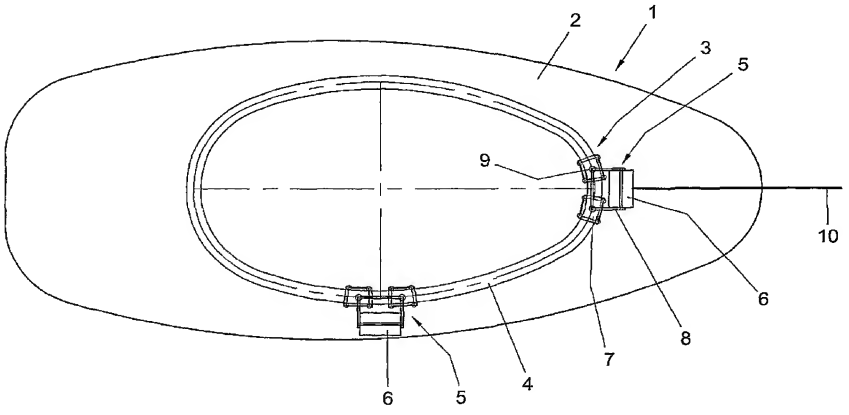
(54) Title: TUG WITH MOVABLE TOWING INSTALLATION



(57) Abstract: A tug (1) with a deck construction on which a towing installation (3) is mounted/ which is provided with a seat (5) , a towing unit (6) carried by the seat and an endless rail construction (4) which is fixedly connected to the deck construction and forms a guide track for carrying the seat in a movable manner, so that a force applied to the towing unit can be transmitted via the seat, the rail construction and the deck construction to the tug, while moving the seat along the rail construction depending on the direction of the applied force. The seat is provided with at least two moving units (7) , which are movable in a guided manner through the endless rail construction and are each connected, mutually independently, to the towing unit by a hinge construction with a central axis which extends substantially perpendicularly to a substantially horizontal plane defined by the rail construction.

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Title: Tug with movable towing installation.

The invention relates to a tug with a deck construction on which a towing installation is mounted, which is provided with a seat, a towing unit carried by the seat and an endless rail construction which is fixedly connected to the deck construction and forms a guide track for carrying the seat in a movable manner, so that a force applied to the towing unit can be transmitted via the seat, the rail construction and the deck construction to the tug, while moving the seat along the rail construction depending on the direction of the applied force.

With such a tug, known from, for instance, French patent 1.158.501, the towing unit can always be optimally positioned, independently of the direction of the force to be applied or the position of the tug relative to the vessel to assist. As a result, not only the effective manoeuvring capacity of the tug can be increased but also, the risk of capsizing can be considerably reduced too, in particular when the towing cable extends transversely to the tug. Alternatively, the forces applied to the towing installation, which can be very considerable, must also be absorbed in the rail construction, that is, the mobile connection between the seat and the rail, the rail itself and the rigid connection of the rail to the deck. This leads to heavy, solid and expensive constructions.

The object of the invention is to design the towing installation in such a manner that construction can be relatively light, in particular also when great to very great forces are to be absorbed, all this while maintaining an optimal adjustability of the towing unit.

A further object of the invention is to provide an efficient possibility for absorbing both horizontal and vertical forces.

A still further object of the invention is to provide a towing installation whose design can not only be relatively light but which is also

relatively insusceptible to tolerance, despite the presence of a curved guide track.

To that end, with a tug according to the above-described type, it is suggested that the seat be provided with at least two moving units which can be moved in a guided manner through the endless rail construction and which are each connected, mutually independently, to the towing unit by a hinge construction with a central axis which extends substantially perpendicularly to a substantially horizontal plane defined by the rail construction. Due to these features, the force to be absorbed can be distributed over several locations or areas long the guide track, while it is also provided that the towing unit can position and adjust itself in the desired manner while the lengthened train of movement can negotiate the curves in the endless guide track without getting jammed for enabling the intended directing and adjusting of the towing unit.

Optimal possibilities for mounting the towing unit firmly and reliably, in combination with mutually independent rotation of the moving units relative to the towing unit can be advantageously realized when each moving unit is connected by its hinge construction to an intermediate frame which forms part of the seat and carries the towing unit.

Here, a further distribution of the force to be absorbed over the guide track in combination with an optimal possibility of movement along the guide track can be realized when each moving unit takes support via, each time, at least two wheels against a running surface of the rail construction formed by the guide track. To then ensure that the force distribution is as even as possible, it is preferred that each moving unit is provided with two wheels, arranged symmetrically relative to the hinge construction. Here, a further refinement of this principle of equalizing of forces can be obtained when two moving units are arranged such that the distance between two wheels deviates each time less than 20% from the other distances between two wheels. It can be provided that then, for each point of the track, the maximum force is substantially equal and as minimal as possible.

Designing the rail construction as lightly as possible yet sufficiently strong can further be promoted when the distance between the two wheels of the moving units located farthest apart is at least 25% of the greatest width of the tug at the location of the towing installation, width being understood to mean the customary shipping term, that is, the width of the hull measured between the insides of the shell plating.

The force absorption will be optimal when the applied force is perpendicular to the track. However, it will be clear that this will certainly not always be the case. Certain fluctuations in the force direction can be absorbed by the rolling butt contact the wheels make with the track. However, situations may arise where the towing cable includes an angle with the water surface of, for instance, 25°, and the deck, when towing laterally, inclines for instance 20°. The angle between the towing cable and the decks is then in the order of magnitude of 45°, which means that at the location of the track, the applied force has a vertical component which is as great as the horizontal component. To then ensure a correct, complete and reliable force absorption, according to a further embodiment of the invention, it can then be provided that at least one wheel is provided with at least one flange, which can contact a support surface formed by the guide track, which includes an angle with the track. The cooperation between flange and support surface then ensures the absorption of the force component parallel to the running surface. It is noted that such a vertical force component can also be absorbed in a different manner than the preferred manner mentioned, for instance by rollers pivotable about a horizontal axis, which engage a bottom side of the guide track, or by gliding surfaces or by a suitable combination of flanges, rollers and gliding surfaces.

The force absorption can be improved even further by providing the guide track with a counter-running surface, which faces away from the running surface and against which counter-wheels, carried by a moving unit can find support, and by providing each of the counter-wheels with a flange

that can be brought into contact with a corresponding support surface. Designing the moving units with wheels and counter-wheels promotes the ease with which the seat is moved along the rail construction, independently of the presence of flanges or similar means.

As stated, circumstances may arise wherein the tug may start heeling over considerably relative to the waterline. In this connection it is preferred that the towing installation, in combination or not in combination with the entire deck construction, is placed at a height above the waterline such that it is not submerged at least up to an angle of inclination of 20°. In such cases it is further preferred that the intermediate hinge is provided with a flexible connection, such as a hinge, so that the towing unit can position itself, relative to the moving units, to an angle of inclination adopted by the applied force. It is preferred here that the flexible connection is located close to the moving units and it can then also have the form of an integrated hinge construction allowing both horizontal and vertical movements. It is also possible to utilize a so-called chain link consisting of an axis and an oversized ring with rounded off inside.

By designing the train of movement to be articulated, a construction is realized which, particularly in the case of a displacement element embracing the rail with some clearance, is relatively insusceptible to tolerance so that, also, wear, damage and deformations during use will lead to the towing installation becoming ineffective considerably less rapidly. This further also offers advantages in terms of manufacturing while, furthermore, it increases the possibilities in design for the endless rail construction. For instance, without experiencing any problems, a guide track can be chosen which has the form of an oval with a longitudinal axis and a shorter lateral axis, while it is also clearly possible that the guide track is of curved design over its entire circumference and has at least two mutually different curvature radii. There, the possibility is also presented to adjust the form optimally to the form of the tug by providing that the oval, viewed in the direction of the longitudinal axis,

is more strongly curved at one end than at the other end, and is therefore, as it were, egg-shaped. When determining the optimal shape it is possible to provide specially adjusted forms. For instance, with smaller tugs with relatively low dynamic forces it can be preferred that the part with sharper curvature is located in the, usually, tapering bow of the tug and the less curved part adjacent the stern. Hence, in the majority of towing situations, in the area where the seat will be located, the rail will only have a slight curvature which, in the field of towing, is considered a further advantage. By contrast, for larger tugs with relatively great dynamic forces it can indeed be an advantage to use a reverse design, that is, the rounder part of the ovoid at the front side and the more pointed part at the rear side.

The guide track can also be designed with a series of mutually different curvature radii, while it is nevertheless preferred that the longitudinal axis is an axis of symmetry and the longitudinal axis extends in the longitudinal direction of the tug, while the length of the lateral axis is in the order of magnitude of 80 or 90% of the width of the tug and the minimal curvature radius is at least equal to 25% of the length of the lateral axis.

With reference to embodiments represented in the drawing, albeit exclusively as non-limitative examples, the tug according to the invention will presently be further elucidated. In the drawing:

Fig. 1 schematically shows a tug with towing installation in top plan view;

Fig. 2 shows, in an enlarged scale in top plan view, a part of the towing installation;

Fig. 3 shows a cross-section according to the line III-III in Fig. 2;

Fig. 4 shows a front view of Fig. 2;

Fig. 5 shows a side view of Fig. 2;

Fig. 6 shows a side view of Fig. 2 with the winch in a position modified relative to Fig. 5; and

Fig. 7 shows, in top plan view, a design of the towing installation modified relative to Fig. 2.

The tug 1 represented in Fig. 1 is provided with a deck construction on which a towing installation 3 is provided. The towing installation 3 comprises an endless rail construction 4, a seat 5 and a towing unit in the form of a winch 6. The seat 5 is provided with two moving units 7 and an intermediate frame 8 which is hingedly connected to a moving unit 7, about a central axis 9 each time perpendicular to the plane of the drawing. The endless rail construction 4 forms an oval guide track with a longitudinal axis and a lateral axis, the longitudinal axis extending in the longitudinal direction of the tug 1. The tug 1 has a more pointed bow and a blunter stern. The oval guide track is adapted thereto and is therefore more or less ovoid, which embodiment is particularly suitable for relatively small tugs.

The seat 5 with winch 6 is represented in two different positions, which demonstrates how the moving devices 7 can hinge relative to each other and relative to the intermediate frame 8, to thus follow the curvature of the guide track without jamming when the seat 5 is moved, while, at the same time, positioning the winch 6 in the desired direction. A cable 10 departing from the winch 6 and extending further to a vessel to be manoeuvred (not shown) must be able move freely above the part of the deck construction 2 outside the rail construction 4 when the seat 5 is moved over the rail construction 4. Parts projecting higher above the deck construction 2 than the rail construction 4, such as a pilot house and the like, should therefore be arranged within the rail construction 4.

In Fig. 2, a part of the towing installation 3 is represented on an enlarged scale. Each moving unit 7 is provided on both sides of the rail construction 4 with two axles 11, 12, respectively, perpendicular to the plane of the drawing, while on the axles 11, each time, a wheel 13, and on the axes 12, each time, a counter-wheel 14 is bearing mounted, as is apparent from Figs. 3 - 5. The wheels 13, arranged symmetrically relative to the central

axis 9, run over a running surface 15 and the counter-wheels 14, also arranged symmetrically relative to the central axis 9, run over a counter-running surface 16, located opposite the running surface 15. The running surface 15 and the counter-running surface 16 are provided with exchangeable treads and are intended to absorb forces applied by the winch 6 and the intermediate frame 8 to the moving units 7 and for transmitting those forces via the rail construction 4 to the deck construction 2. The running wheel 13 is provided with a flange 13a that reaches beyond the running surface 15 under the rail construction 4 and, at that location, can contact a support surface formed there. In a similar manner, a flange 14a of the counter-wheel 14 reaches under the rail construction 4 so that in a simple yet reliable manner a possibility is provided for absorbing a vertical force component transmitted by the intermediate frame 8 to the moving unit 7. Via bearing rollers 17, the moving units 7 rest on the topside of the rail construction 4.

As already stated, the intermediate frame 8 is hingedly coupled to each moving unit 7 around a central axis 9 which, in Fig. 2, extends perpendicular to the plane of the drawing. The intermediate frame 8 itself is composed of two parts 8a and 8b, which can hinge relative to each other around a central axis 18 indicated in Fig. 5 and, at that location, perpendicular to the plane of the drawing. Here, the part 8a is provided with means for realizing the hinging connection to the moving units around the central axis 9, and the part 8b carries the winch 6, which is thus pivotally arranged and finds support on the deck construction 2 via rollers 19. Due to a thus pivotally arranged winch 6, in the situation shown in Fig. 6, where the cable 10 extends at a relative large angle of approximately 45° relative to the deck construction 2, the extension of the cable 10 will always intersect with the rail construction 4 which, from a point of view of forces and moments, offers considerable advantages to the mobile connection between the rail construction 4 and the seat 5. The angle referred to between the cable and the deck construction 2 may be the result of a cable 10 extending upward towards

the vessel to be manoeuvred and/or an inclining position the deck construction 2 may adopt as a result of the generation of a tractive force in the cable 10 between the tug 1 and the vessel to be manoeuvred.

When applying a tractive force to the towing installation 3 via the cable 10, this force will be transmitted to the relatively long, articulated train consisting of two moving units with two wheels 13 each and therefore be transmitted to the rail construction 4 spread over a relatively great length. As the wheels 13 of a moving unit 7 are arranged symmetrically relative to the central axis 9, both wheels will be loaded evenly. By further arranging the four wheels 13 of the two moving units 7 in a substantially evenly distributed manner, this effect can even be improved. All this leads to the rail construction 4 and the connection thereof to the deck construction 2 to be of relatively light design, while the movability specific to the articulated train enables the seat 5 to move along the curved guide track without problems upon movements between the tug 1 and a vessel manoeuvred thereby.

If the towing operations were to cause the cable 10 to deviate from the horizontal position shown in Fig. 5, or if the tug 1 were to start heeling over, then it is ensured in an efficient an reliable manner, as appears from Fig. 6, that with the aid of the flanges 13a and 14a, also a vertical force component can be transmitted by the moving units 7 to the rail construction 4.

In Fig. 7 is represented an embodiment of the towing installation, modified when compared to Fig. 2, where identical parts are indicated with identical reference numerals. In particular the rail construction 4 and the moving units 7 are involved here. The intermediate frame 8' is designed with a part 8a which is identical to that of Fig. 2, which also holds for the design of the hinging connection to the moving units 7. Different from Fig. 2 is the second part of the intermediate frame 8', presently indicated with 8c, which, presently, does not carry a winch as towing unit but an attachment device such as a towing hook, for coupling a cable 10 to a towing eyelet 10a, in a symmetrical manner relative to the moving units 7, which cable extends

further to the vessel to be manoeuvred. In the same manner as the part 8b in Fig. 1, the part 8c is, once more, hingedly connected to the part 8a, so that with the cable 10 in an inclining position, the same advantages are obtained as described earlier in connection to the winch 6.

It is self-evident that within the framework of the invention as laid down in the accompanying claims, many modifications and variations are possible. For instance, more than two moving units can be utilized and a moving unit can have more or fewer than two wheels on one side, which number, in turn, can deviate from the number on the other side of the rail construction. If so desired, other suitable means for realizing the movement between a moving unit and the rail construction can be utilized too. Also, the hinging arrangement of the winch around a horizontal axis can be omitted and provisions may be present to fix the seat on a particular location on the rail construction. In addition, the moving units can be provided with mechanical drive means and/or brake means. Further, the guide track can have any desired and suitable form other than the represented ovoid, more particularly have several curvature radii or be provided with straight stretches. Further, both the towing installation 2 and (a part of) the deck construction 3 may be provided so as to be raised relative to the water line, so that also when the tug inclines, the deck construction 2 and the towing installation 3 always remain above water. It is noted here that a higher deck offers two advantages. This results in, on the one side, a larger water-tight volume and therefore in a larger buoyancy and, on the other side, that water will be shipped considerably less rapidly, so that the risk of the hull being dynamically submerged is reduced.

Claims

1. A tug with a deck construction on which a towing installation is mounted, which is provided with a seat, a towing unit carried by the seat and an endless rail construction which is fixedly connected to the deck construction and forms a guide track for carrying the seat in a movable manner, so that a force applied to the towing unit can be transmitted via the seat, the rail construction and deck construction to the tug, while moving the seat along the rail construction depending on the direction of the applied force, wherein the seat is provided with at least two moving units which are movable in a guided manner through the endless rail construction and which are each connected, mutually independently, to the towing unit by a hinge construction with a central axis which extends substantially perpendicularly to a substantially horizontal plane defined by the rail construction.

2. A tug according to claim 2, wherein each moving unit is connected by its hinge construction to an intermediate frame which forms part of the seat and carries the towing unit.

3. A tug according to claim 1 or 2, wherein each moving unit takes support, via, each time, at least two wheels, against a running surface of the rail construction formed by the guide track.

4. A tug according to claim 3, wherein each moving unit is provided with two wheels which are arranged symmetrically relative to the hinge construction.

5. A tug according to claim 3 or 4, wherein two moving units are arranged such that the distance between two wheels deviates each time less than 20% from the other distances between two wheels.

6. A tug according to any one of claims 3 – 5, wherein the distance between the two wheels of the moving units located farthest apart is at least 25% of the greatest width of the tug at the location of the towing installation.

7. A tug according to any one of claims 3 – 6, wherein at least one wheel is provided with at least one flange, which can contact a support surface formed by the guide track which includes an angle with the running surface.

8. A tug according to any one of claims 3 – 7, wherein the guide track is provided with a counter-running surface which faces away from the running surface and against which counter-wheels carried a moving unit can find support.

9. A tug according to any one of the preceding claims, wherein the towing installation is placed at a height above the water line such that it is not submerged at least up to an angle of inclination of 15°.

10. A tug according to claim 9, wherein also the entire deck construction is placed at a height above the water line such that it is not submerged at least up to an angle of inclination of 15°.

11. A tug according to any one of the preceding claims, wherein the intermediate frame is provided with a flexible connection, such as a hinge, so that the towing unit can position itself, relative to the moving units, to an angle of inclination adopted by the applied force.

12. A tug according to any one of the preceding claims, wherein the guide track has the shape of an oval with a longitudinal axis and a shorter lateral axis.

13. A tug according to claim 12, wherein the guide track is of curved design over its entire circumference and has at least two mutually different curvature radii.

14. A tug according to claim 12 or 13, wherein the oval, viewed in the direction of the longitudinal axis, is more strongly curved at one end than at the other end.

15. A tug according to any one of claims 12 – 14, wherein the longitudinal axis is an axis of symmetry.

16. A tug according to any one of claims 12 – 15, wherein the longitudinal axis extends in longitudinal direction of the tug.

17. A tug according to any one of claims 12 – 16, wherein the length of the lateral axis is in the order of magnitude of 80 to 90% of the width of the tug.

18. A tug according to any one of claims 12 – 17, wherein the minimum curvature radius is at least equal to 25% of the length of the lateral axis.

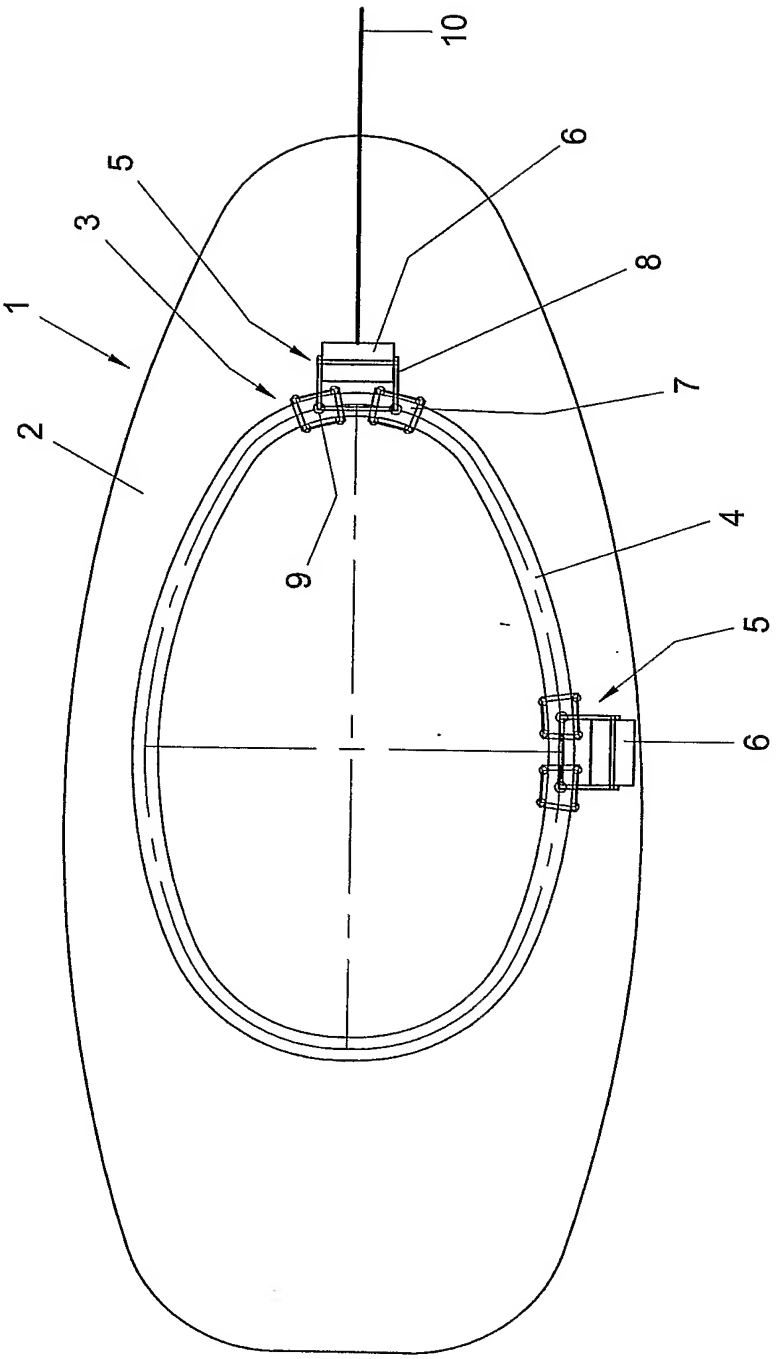

Fig. 1

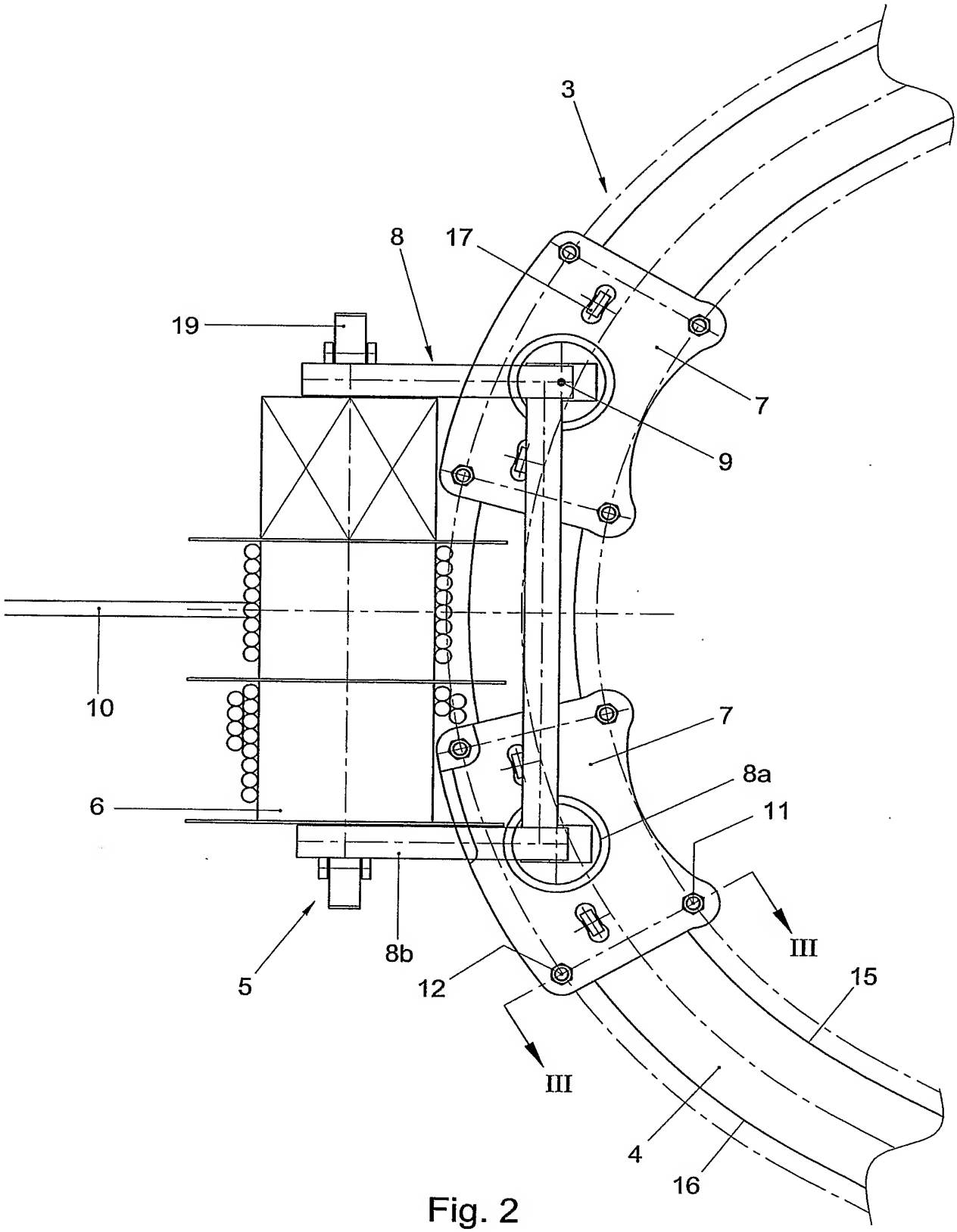

Fig. 2

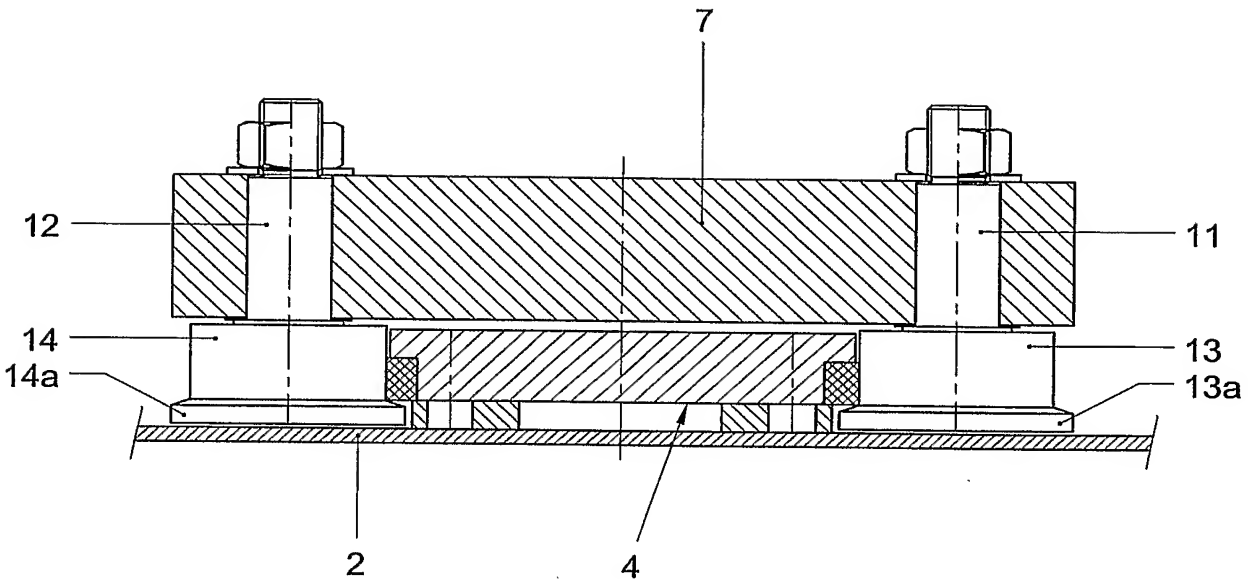

Fig. 3

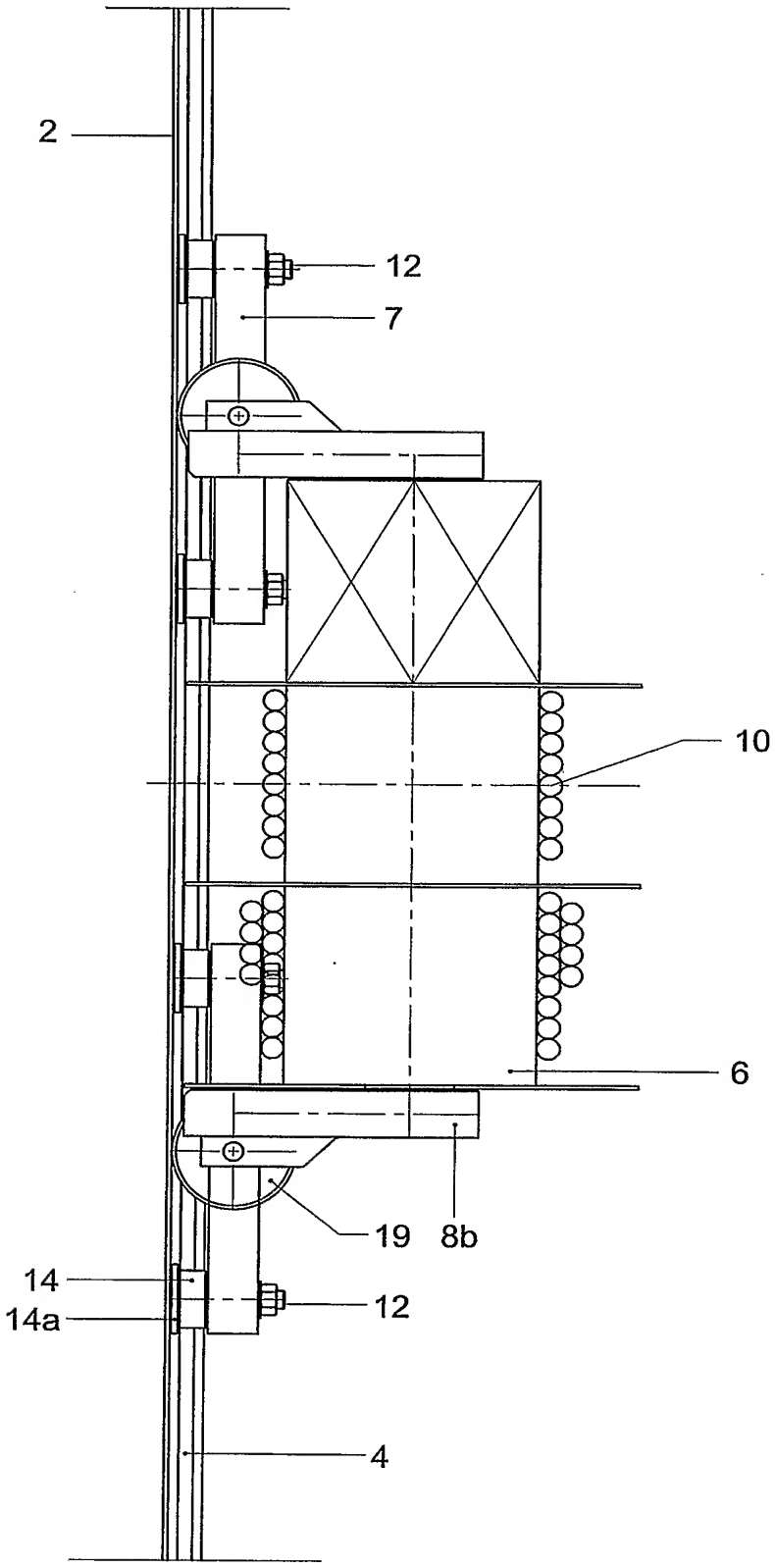

Fig. 4

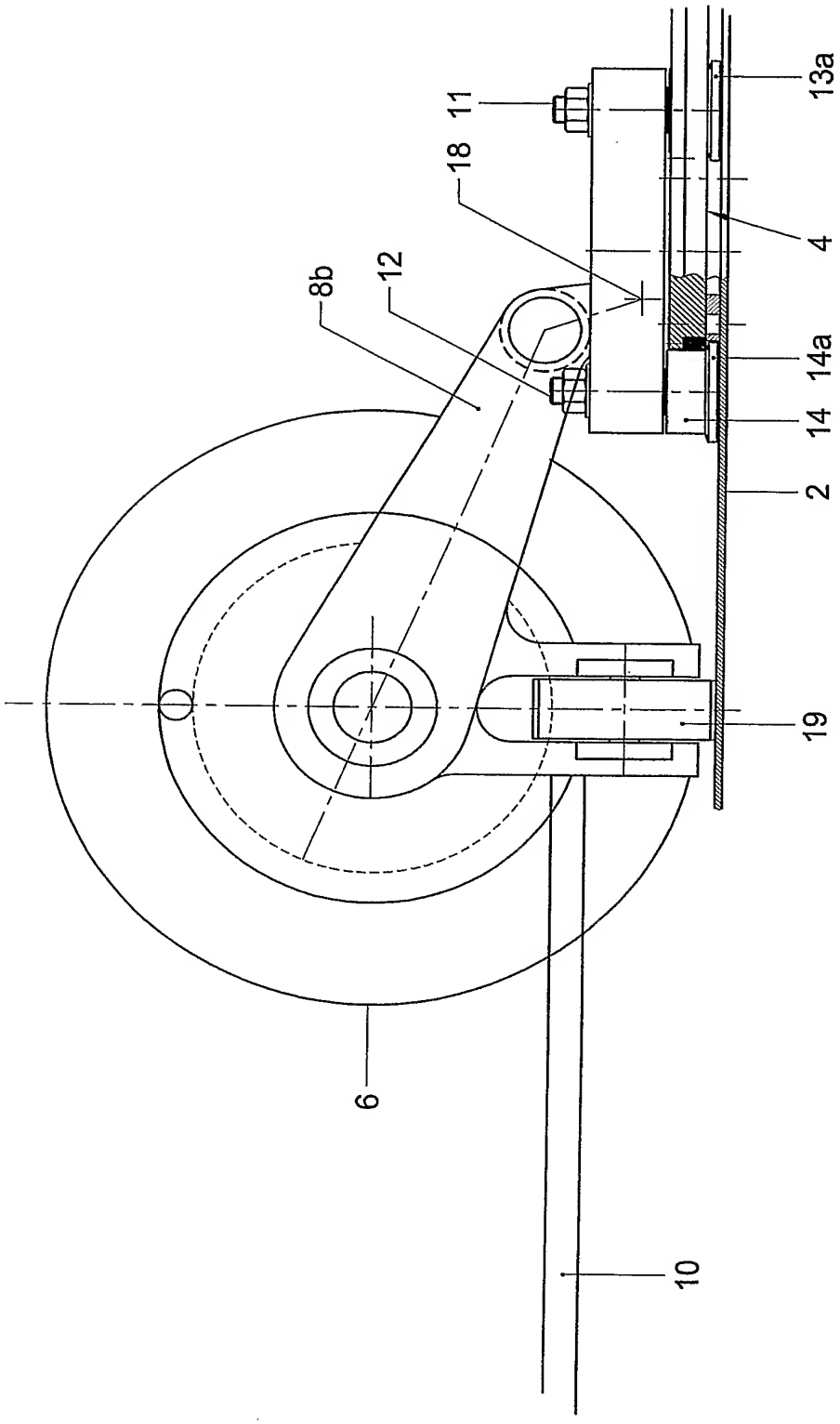

Fig. 5

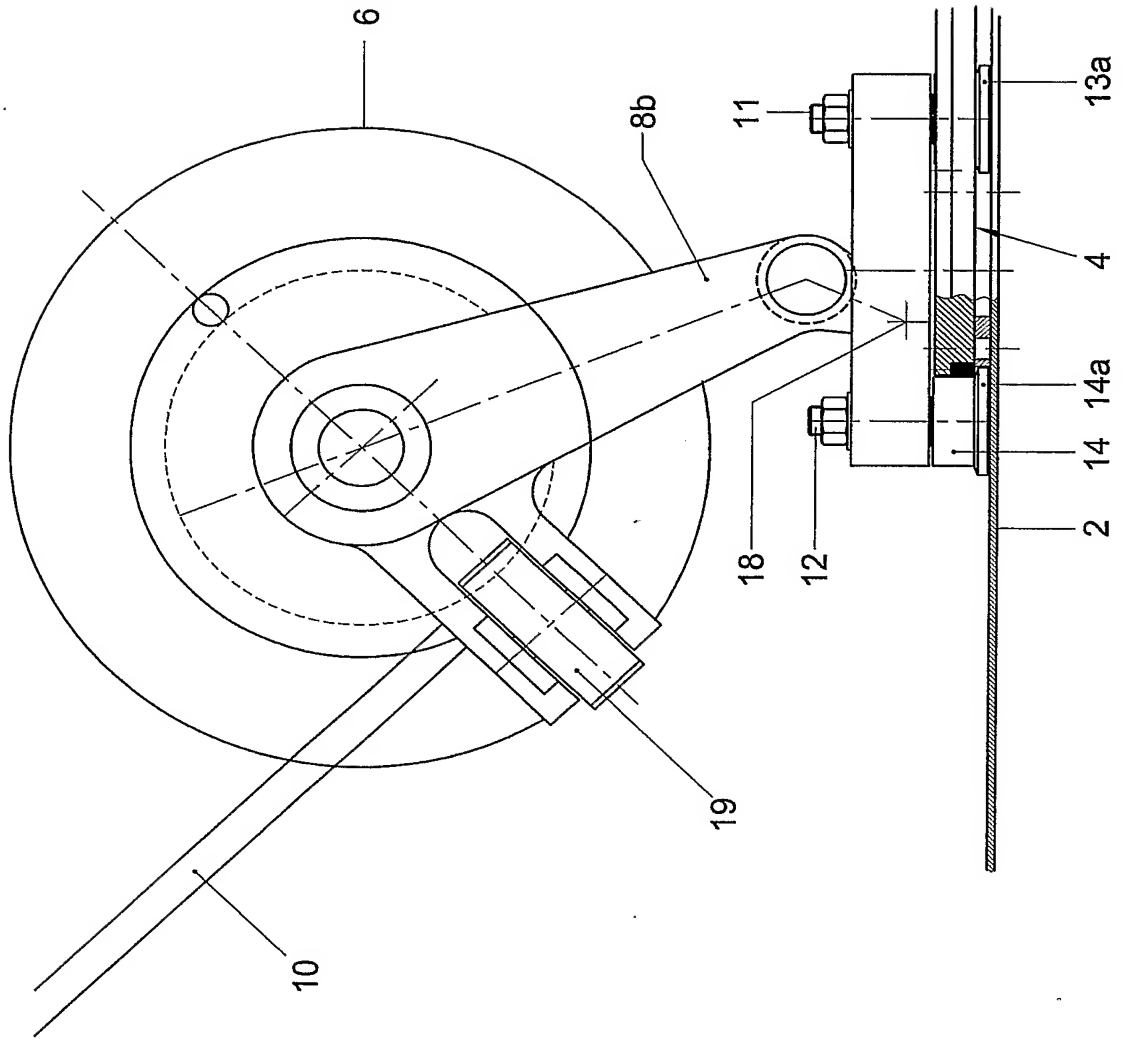

Fig. 6

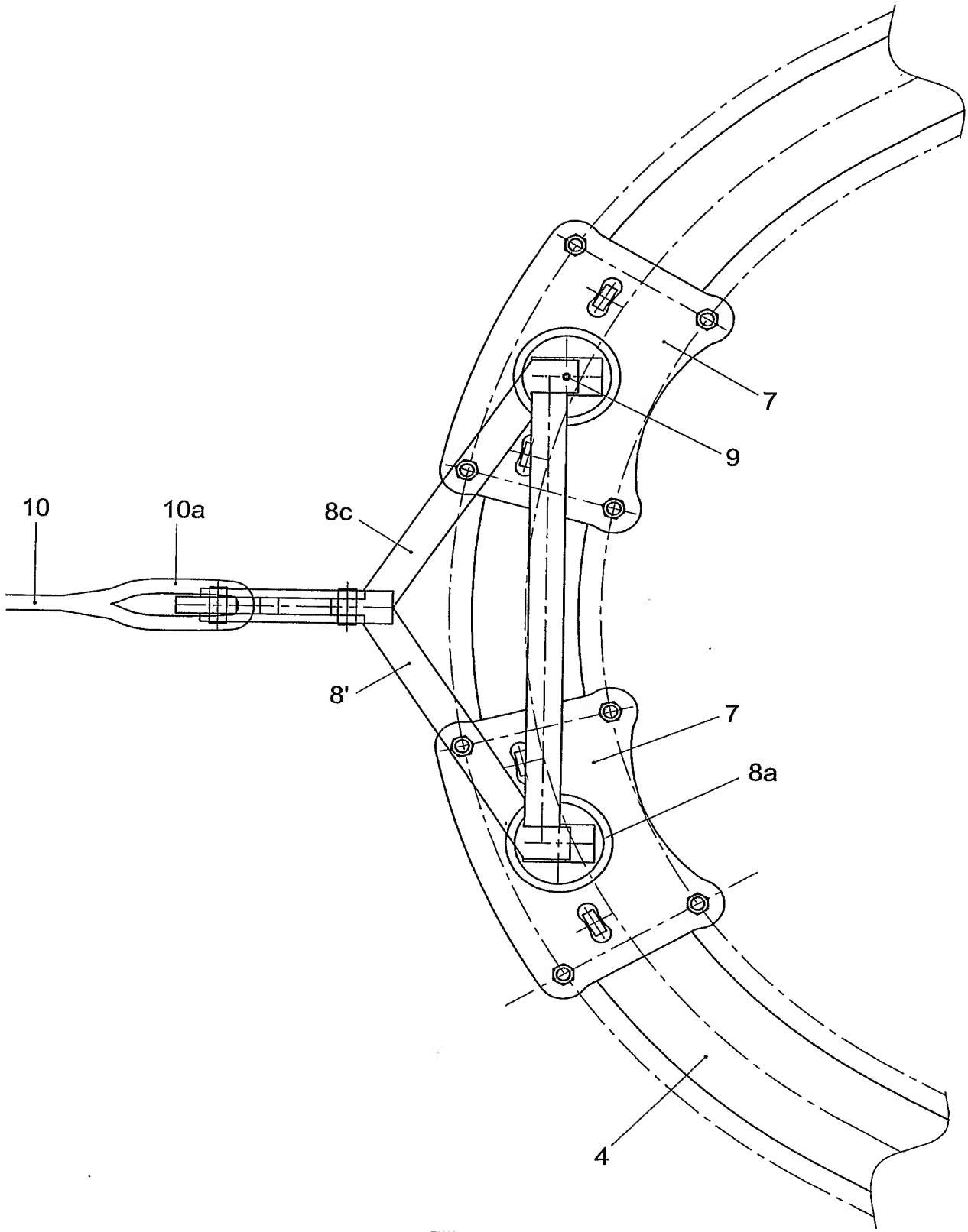

Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/NL2005/000776

A. CLASSIFICATION OF SUBJECT MATTER
B63B21/56 B63B35/68

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 24 53 422 A1 (PEKELER,GERD) 13 May 1976 (1976-05-13) page 4, line 11 - page 5, line 2 page 6, lines 8-16 figures	1-18
A	US 3 911 850 A (BAER ET AL) 14 October 1975 (1975-10-14) column 4, line 47 - column 5, line 13; figures 5-9	1-18
A	WO 2004/012989 A (SAR REMOLCADORES, S.L; ENCOPIM, S.L; VILA BOIXADERA, JOSEP; MEDINA VID) 12 February 2004 (2004-02-12) page 7, lines 1-13; figures 4,5	1-18

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 January 2006	12/01/2006

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vermeulen, T

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 158 501 A (MERY,FRANÇOIS-PAUL) 16 June 1958 (1958-06-16) cited in the application figures 2,4,5	1-18
A	DE 881 312 C (SIEMENS-SCHUCKERTWERKE AKTIENGESELLSCHAFT) 29 June 1953 (1953-06-29) claim 4	1-18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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PUBN-DATE: May 11, 2006

INVENTOR-INFORMATION:

NAME	COUNTRY
MAMPAEIJ, GERARDUS ANTONIUS JOZ	NL

ASSIGNEE-INFORMATION:

NAME	COUNTRY
EUROP INTELLIGENCE B V	NL
MAMPAEIJ GERARDUS ANTONIUS JOZ	NL

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ABSTRACT:

CHG DATE=20060602 STATUS=O>A tug (1) with a deck construction on which a towing installation (3) is mounted/ which is provided with a seat (5) , a towing unit (6) carried by the seat and an endless rail construction (4) which is fixedly connected to the deck construction and forms a guide track for carrying the seat in a movable manner, so that a force applied to the towing unit can be transmitted via the seat, the rail construction and the deck construction to the tug, while moving the seat along the rail construction depending on the direction of the applied force. The seat is

provided with at least two moving units (7) , which are movable in a guided manner through the endless rail construction and are each connected, mutually independently, to the towing unit by a hinge construction with a central axis which extends substantially perpendicularly to a substantially horizontal plane defined by the rail construction.